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PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 09 May 2001 (09.05.01)	
International application No. PCT/SE00/01628	**Applicant's or agent's file reference** 110010901/TK
International filing date (day/month/year) 24 August 2000 (24.08.00)	**Priority date** (day/month/year) 31 August 1999 (31.08.99)
Applicant LINDAHL, Olof et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

22 February 2001 (22.02.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

12

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
110010901		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE00/01628	24.08.2000	31.08.1999
International Patent Classification (IPC) or national classification and IPC7		
A61B 3/16		
Applicant		
BIORESONATOR AB et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
22.02.2001	12.12.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Patrik Blidefalk /OGU Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1998)

INTERNATIONAL PRELI[redacted]RY EXAMINATION REPORT

In[redacted]onal application No.
PCT/SE00/01628

I. Basis of the report

1. With regard to the **elements** of the international application:*

☒ the international application as originally filed

☐ the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the claims:
pages _____, as originally filed
pages _____, as amended (together with any statement) under article 19
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the drawings:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language English which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☒ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/01628

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-11	YES
	Claims		NO
Inventive step (IS)	Claims	1-11	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-11	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Prior art

Prior art, cited in the search report, consists of the following documents:

(D1) US 5 375 595, A
(D2) SU 982 649, A
(D3) US 4 930 507, A

D1 describes a non-contact acoustic resonance determination of intraocular pressure, using an ultrasonic transducer; D2 describes an intra-ocular pressure measurement device, with a piezo-quartz resonator; and D3 describes an acoustical tonometer. However, the methods and devices in D1-D3 do not read the characteristics of the contact body and do not form a new resonant system for the determination of the pressure. Therefore, D1-D3 merely defines state of the art.

Statement of reasons

None of documents D1-D3, nor any combination of them, describe such a method, as claimed in claims 1-5; such a device, as claimed in claim 6-10; or the use of the device, as claimed in claim 11. There is also no teaching in the cited art leading a skilled person to this method, device, or use. Therefore, the claimed invention is novel and involves an inventive step.

Accordingly, claims 1-11 are novel (N) and fulfil the requirements of inventive step (IS) and industrial applicability (IA).

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For receiving Office use only 10/069115

International Application No. PCT/SE 00 / 01628

International Filing Date 24-08-2000

The Swedish Patent Office
PCT International Application

Name of receiving Office and "PCT International Application"

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 110010901/TK

Box No. I TITLE OF INVENTION

Method and device for measuring the intraocular pressure

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no state of residence is indicated below.)*

EKLUND Anders
Allmogevägen 10
SE-905 96 UMEÅ
SWEDEN

☒ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: SWEDEN

State *(that is, country)* of residence: SWEDEN

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no state of residence is indicated below.)*

LINDAHL Olof
Gökropsvägen 10H
SE-906 51 UMEÅ
SWEDEN

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: SWEDEN

State *(that is, country)* of residence: SWEDEN

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below ~~is hereby~~/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Per Tomas Karlsson
AB STOCKHOLMS PATENTBYRÅ , Zacco & Bruhn
Box 23101, SE-104 35 STOCKHOLM, Sweden

Telephone No. +46 8 729 95 00

Facsimile No. +46 8 31 83 15

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **MZ** Mozambique, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgystan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH** and **LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain., **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the FCT *(if other kind of protection or treatment desired, specify on dotted line)*

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒	**AE**	United Arab Emirates
☒	**AG**	Antigua and Barbuda
☒	**AL**	Albania
☒	**AM**	Armenia
☒	**AT**	Austria
☒	**AU**	Australia
☒	**AZ**	Azerbaijan
☒	**BA**	Bosnia and Herzegovina
☒	**BB**	Barbados
☒	**BG**	Bulgaria
☒	**BR**	Brazil
☒	**BY**	Belarus
☒	**CA**	Canada
☒	**CH and LI**	Switzerland and Liechtenstein
☒	**CN**	China
☒	**CR**	Costa Rica
☒	**CU**	Cuba
☒	**CZ**	Czech Republic
☒	**DE**	Germany
☒	**DK**	Denmark
☒	**DM**	Dominica
☒	**DZ**	Algeria
☒	**EE**	Estonia
☒	**ES**	Spain
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☒	**GB**	United Kingdom
☒	**GD**	Grenada
☒	**GE**	Georgia
☒	**GH**	Ghana
☒	**GM**	Gambia
☒	**HR**	Croatia
☒	**HU**	Hungary
☒	**ID**	Indonesia
☒	**IL**	Israel
☒	**IN**	India
☒	**IS**	Iceland
☒	**JP**	Japan
☒	**KE**	Kenya
☒	**KG**	Kyrgyzstan
☒	**KP**	Democratic People's Republic of Korea
☒	**KR**	Republic of Korea
☒	**KZ**	Kazakhstan
☒	**LC**	Saint Lucia
☒	**LK**	Sri Lanka
☒	**LR**	Liberia
☒	**LS**	Lesotho
☒	**LT**	Lithuania
☒	**LU**	Luxembourg
☒	**LV**	Latvia
☒	**MA**	Morocco
☒	**MD**	Republic of Moldova
☒	**MG**	Madagascar
☒	**MK**	The former Yugoslav Republic of Macedonia
☒	**MN**	Mongolia
☒	**MW**	Malawi
☒	**MX**	Mexico
☒	**MZ**	Mocambique
☒	**NO**	Norway
☒	**NZ**	New Zealand
☒	**PL**	Poland
☒	**PT**	Portugal
☒	**RO**	Romania
☒	**RU**	Russian Federation
☒	**SD**	Sudan
☒	**SE**	Sweden
☒	**SG**	Singapore
☒	**SI**	Slovenia
☒	**SK**	Slovakia
☒	**SL**	Sierra Leone
☒	**TJ**	Tajikistan
☒	**TM**	Turkmenistan
☒	**TR**	Turkey
☒	**TT**	Trinidad and Tobago
☒	**TZ**	Tanzania
☒	**UA**	Ukraine
☒	**UG**	Uganda
☒	**US**	United States of America
☒	**UZ**	Uzbekistan
☒	**VN**	Viet Nam
☒	**YU**	Yugoslavia
☒	**ZA**	South Africa
☒	**ZW**	Zimbabwe

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after Issuance of this sheet:

☒	**BZ**	Belize
☒	**BT**	Bhutan Deleted on by RO/SE
☐		
☐		
☐		

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

PCT/SE 00/01628
24-08-2000

Box No. VI PRIORITY CLAIM ☐ Further priority claim indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application: * regional Office	international application: receiving Office
item (1) 31/08/1999	9903099-1	Sweden		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA /SE

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)*	Number	Country *(or regional Office)*
31/08/1999	99/01124	Sweden

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	:4
description (excluding sequence listing part)	:4
claims	:2
abstract	:1
drawings	:1
sequence listing part of description	:
Total number of sheets:	12 ✓

This international application is **accompanied** by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other *(specify)*: List of representatives

Figure of the drawings which should accompany the abstract: Fig. 1

Language of filing of the international application: Swedish

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Stockholm, 24 Aug. 2000

Stefan Lennefors
Representative of the applicant

For receiving Office use only

1. Date of actual receipt of the purported international application:	24-08-2000	2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA / SE	☐ 6. Transmittal of search copy delayed until search fee is paid	

For International Bureau use only

Date of receipt of the record copy by the International Bureau: 25 SEPTEMBER 2000 (25.09.00)

See Notes to the request form

PCT/SE 00 / 0 1 6 2 8
24 -08- 2000

Supplemental box *If the Supp[illegible]l Box is not used, this sheet should not be included in [illegible]uest.*

1. *If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular.*

(i) ***If more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is country) of residence if no State of residence is indicated below:***

(ii) ***If, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant:***

(iii) ***If, in Box No. II or in any of the sub-boxes of Box No. III,*** *the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America:* ***in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicated the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor:***

(iv) ***If, in addition to the agent(s) indicated in Box No IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;***

(v) ***If, in Box No. V, the name of any State (orOAPI) is accompanied by the indication "patent addition" or "certificate of addition" or if, in Box No V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part":*** *in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application:*

(vi) ***If, in Box No VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No VI" and indicated for each additional earlier application the same type of information as required in Box No VI:***

(vii) ***If, in Box No VI,*** *the earlier application is an ARIPO application:* ***in such case, write "Continuation of Box No VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.***

2 ***If, whit regard to the*** *precautionary designation statement* ***contained in Box No V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.***

3 ***If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning*** *non-prejudicial disclosures of exceptions to lack of novelty:* ***in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.***

CONTINUATION OF BOX IV:

Further representatives:

Agvald-Glas, Gunilla
Bernhult, Lennart
Forssén, Catarina
Grahn, Cecilia
Granström, Lars-Eric
Grip, Joakim
Hansson, Hans-Erik
Hansson, Sven A.
Hinz, Udo
Karlsson, Per Tomas
Lennefors, Stefan ✓
Lundström, Maria
Nilsson, Brita
Nordén, J. Åke
Onn, Thorsten
Rilton, Kristina
Westerlund, Örjan
Åström, Elsa

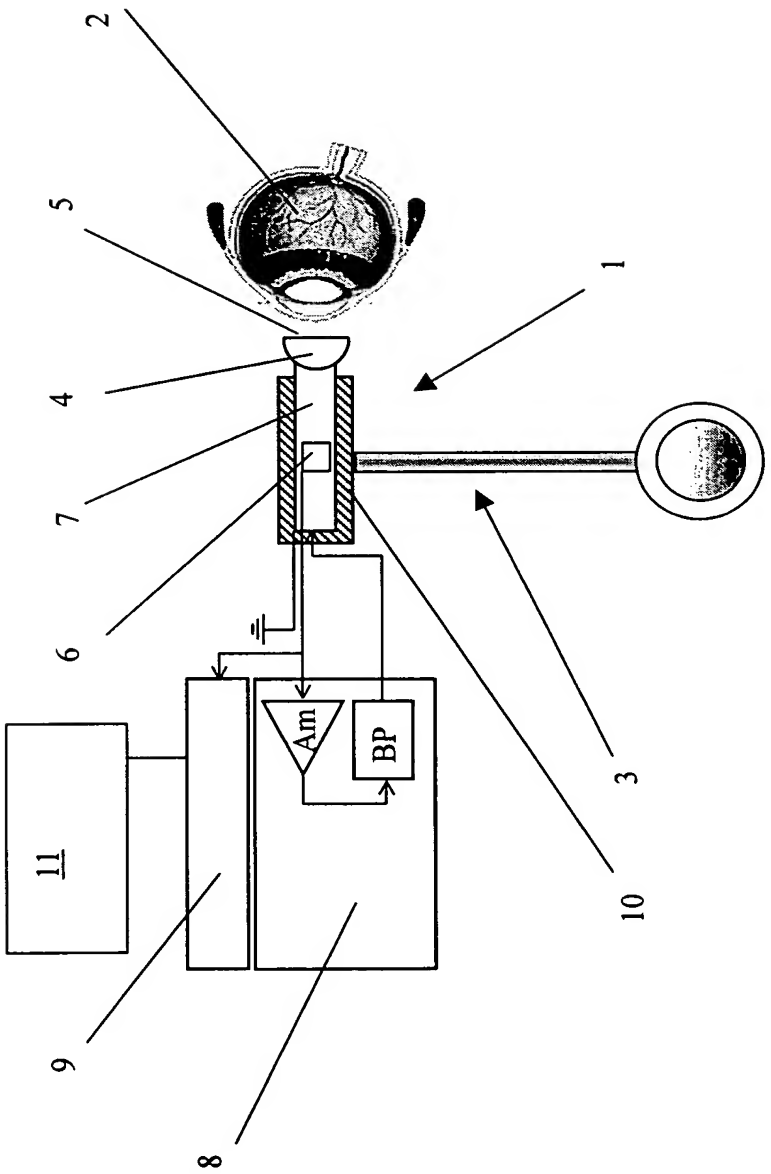

fig. 1

Metod och anordning för mätning av det intraokulära trycket. ~~**Method and device for measuring the intraocular pressure.**~~

Föreliggande uppfinning avser en metod och en anordning för bestämning av det invändiga trycket i ett öga, det sk intraokulära trycket (IOP).

Eftersom långvariga förhöjda tryck i det mänskliga ögat kan leda till blindhet mäts trycket rutinmässigt vid alla ögonkliniker. På klinik används vanligen en applanationsmetod, t ex den sk Goldman applanationstonometern, vilken innebär att en sond anbringas mot ögat tills en förutbestämd deformation uppnåtts och erforderlig kraft avläses.

Grunden i tryckbestämningen är sedan det kända sambandet mellan tryck, kraft och area:

$$p = \frac{F}{A}$$ där p=tryck, F=kraft och A=area

Ögats inre tryck kan alltså beräknas ur ansättningskraften och ögats deformationsarea.

För att fastställa när en bestämd deformation (area) uppnåtts påförs ögat en fluorescerande kemikalie och ögat belyses så att förändringar i ljusreflexer vid deformationen kan avläsas.

En andra metod används då kravet på noggrannhet inte är lika högt ställt. Det är en tryckluftmetod där en tryckluftstöt används för att deformera ögat med en bestämd kraft, varvid deformationen avläses genom detektion av ljusreflexer. Denna metod är utan fysisk kontakt mellan fast föremål och ögat.

Båda metoderna bygger på att en kraft deformerar ögat, vilket patienten kan uppleva obehagligt eller smärtsamt trots att lokalbedövning används t ex vid Goldman-metoden.

Den förra metoden har vidare visat sig vara känslig för astigmatism, då ljusbrytning alltid nyttjas vid mätningen av ögats deformation. Den senare metoden har dokumenterat bristande noggrannhet och används därför inte då nominellt tryck skall fastställas, utan ofta av optiker etc för en första avläsning av tryckets storleksordning.

Det finns alltid en risk för skador på ögat, särskilt hornhinnan, när ögat ansätts. Det är ett skäl till att det är önskvärt att minimera den ansättande kraften. Den minsta möjliga kraften bestäms enligt formeln ovan av den area eller deformation som erfordras för att denna korrekt skall kunna detekteras. De ljusreflexmetoder som används för att detektera eller avläsa deformationsarea erfordrar en relativt stor area för korrekt avläsning och därmed en i motsvarande mån relativt stor kraft.

Det är ett syfte med föreliggande uppfinning att mildra eller övervinna de ovan angivna nackdelarna med kända metoder och anordningar för mätning av det invändiga trycket i ett öga.

Detta syfte uppnås med en metod och en anordning som först nämnts ovan och som uppvisar de särdrag som definieras i de följande självständiga patentkraven.

Dessa och ytterligare särdrag och fördelar med uppfinningen kommer att framgå av den följande detaljerade beskrivningen av föredragna utföringsformer av uppfinning, vilka utgör ett exempel och således ej är begränsande för uppfinningens skyddsomfång. För att underlätta förståelsen är i texten införda hänvisningar till bifogad ritningsfigurer, i vilka ekvivalenta eller liknande delar givits samma hänvisningsbeteckning. Fig. 1 visar schematiskt delar i en anordning enligt en utföringsform av uppfinningen.

Enligt föreliggande uppfinning används en vibrerande eller oscillerande kontaktkropp som ansätts mot ögat för att bestämma ögats deformation.

Vi har funnit att förändringen i frekvenskaraktäristik mellan dels ett i resonans svängande system dels det systemet bringat i kontakt med ett öga för bildande av ett nytt i resonans svängande system är beroende av kontaktytans area.

En metod för bestämning av trycket p i ett öga, det sk intraokulära trycket innefattar att en kontaktkropp med känd geometri ansätts mot ögat med en successivt ökande kraft F och att när ögats deformationsarea A bestämts kan trycket erhålls ur sambandet $p = \frac{F}{A}$. Det för uppfinningen nya är att avläsa frekvenskarakteristiken f_{karr} hos ett kontaktkroppen tillhörande och i resonans svängande sensorsystem, att därefter ansätta kontaktkroppen mot ögat för bildandet av ett nytt i resonans svängande system, att avläsa ansättningskraften och frekvenskarakteristiken för det nya systemet samt att förändringen i frekvenskaraktäristik beräknas, varvid ögats tryck kan bestämmas då den eftersökta deformationsarean A är en funktion av förändringen $A(\Delta f_{karr})$, kalibrerat för aktuellt sensorsystem. Kalibrering av mätinstrument och mätanordningar är kända moment och kommer därför inte närmare att beskrivas här.

Den kraft med vilken kontaktkroppen ansätts mot ögat kan således anpassas beroende av ögats tryck så att ett lägre tryck bestäms med en lägre ansättningskraft och ett högre tryck bestäms med en högre ansättningskraft, varvid erhålls hög mätnoggrannhet med minimal ansättningskraft i stora tryckintervall.

I en alternativ utföringsform kan frekvenskarakteristiken avläsas kontinuerligt och ansättningskraften F ökas till dess en önskad förändring i frekvenskarakteristik Δf_{karr} uppnåtts,

varvid ansättningskraften F avläses och trycket beräknas som en funktion av ansättningskraften F vid bestämd frekvenskarakteristikförändring Δf_{karr}.

I ytterligare en utföringsform kan upprepade avläsningar utföras av ansättningskraft F och frekvenskarakteristik under en ansättning av kontaktkroppen mot ögat, varvid en serie mätvärden erhålls. En serie mätvärden ökar möjligheten att identifiera och avfärda mätvärden som faller utanför det tillförlitliga mätområdet, t ex för att ansättningskraften var för låg eller för att kraften blev så stor att kontaktarean understeg den bildade deformationen.

Vid mätning och beräkning av frekvenskarakteristik kan t ex användas komponenter som resonansfrekvens eller fas.

I den bifogade figuren visas schematiskt ett arrangemang enligt en utföringsform av föreliggande uppfinning. Arrangemanget visar en sensor 1 anordnad i läge för mätning av det intraokulära trycket i ett öga 2. Sensorn 1 är uppburen av en anordning 3 för reglerad ansättning av sensorn 1 mot ögat. Anordningen 3 kan kontrollera den kraft med vilken sensorn ansätts mot ögat.

Sensorn innefattar en kontaktkropp 4 uppvisande en kontaktyta 5 för anliggning mot ögat.

Kontaktkroppen är i sensorn uppburen av eller utgör en integrerad del av en oscillerande enhet. Den oscillerande enheten 7 är i den visade utföringsformen ett piezoelektriskt element. Det Piezoelektriska elementet har en lämplig upphängning i ett hölje 10 som tillåter att det piezoelektriska elementet svänger så fritt som möjligt. På det piezoelektriska elementet 7 finns ett mindre piezoelektriskt element 6, en sk pickup, förankrat som fångar upp svängningen i piezoelektriska element 7.

Ett drivorgan är anslutet till den oscillerande enheten 7 för åstadkommandet av dess oscillerande rörelse. I föreliggande utföringsform är en återkopplingskrets 8 ansluten till det piezoelektriska elementet 7 som återkopplar svängningen registrerad av pickupen 6 och åstadkommer en resonanssvängning hos systemet.

I den i figurerna schematiskt visade utföringsformen är det piezoelektriska elementet 7 anslutet till jord och till ett bandpassfilter BP. Pickupen 6 är fastlimmad vid det piezoelektriska elementet 7 och anslutet till en förstärkare Am, som i sin tur är ansluten till bandpassfiltret BP för återkoppling. Am och BP trimmas för optimalt svängningsförhållande, dvs resonansfrekvens.

Därtill är en anordning 9 för avläsning av frekvenskaraktäristik ansluten till systemet. Denna kan vara en ordinär frekvensräknare eller annan lämplig signalbehandlingsutrustning.

Vidare är med fördel en beräkningsenhet 11 ansluten till frekvensräknaren för beräkning av frekvensdifferens.

Kontaktytan är i denna utföringsform plan. Ytan kan t ex förses med en struktur eller ett mönster för undanträngning av tårvätska. Kontaktytan kan även vara utförd konkav, med en kurvradie överstigande den för den yta på ögat den är avsedd att ansättas mot.

I en ytterligare utföringsform kan kontaktytan utföras konvex. Detta är föredraget t.ex. vid tryckmätning på öga som uppvisar en plan hornhinna. Plan hornhinna kan t.ex. bli resultatet för den som genomgått synkorrigerande avslipning av hornhinnan, t.ex. genom laserbehandling.

Kontaktkroppen skall vara utförd i ett elektriskt isolerande material förhindrande galvanisk förbindelse mellan det piezoelektriska elementet och ögat. Kontaktkroppen kan med fördel vara utförd i ett polymermaterial. Kontaktkroppen skall vidare uppvisa akustiska egenskaper tillåtande en frekvensöverföring till ögat. De piezoelektriska elementen bör vara inkapslade för att undvika galvanisk förbindelse mellan de piezoelektriska elementen och en patients eller en handhavares kropp.

När systemet bringats att svänga i resonans och systemets frekvenskaraktäristik har avlästs är systemet redo för mätning. Svängande bringas kontaktytan 5 mot ett öga som skall tryckbestämmas. Ansättningskraft och frekvenskaraktäristik för det då bildade i resonans svängande systemet avläses. Vid varje mättillfälle kan en eller flera avläsningar göras.

Med stöd av tidigare gjorda kalibreringar av sensorsystemet kan sedan kontaktarean tolkas ur förändringen i frekvenskaraktäristik $A(\Delta f_{karr})$ och ögats tryck kan fastställas.

För att erhålla tillförlitliga värden måste kontaktytans area överstiga den yta som bildas vid ansättning mot öga.

Fördelen med den här beskrivna metoden är uppenbar då den inte kräver någon på förhand bestämd deformationsarea och därmed inte någon lägsta ansättningskraft för bestämning av trycket. Vidare undviks användandet av fluorescerande kemikalier i ögat.

Eftersom anordningen kan användas för kontinuerlig mätning och informationsinsamling under en mätperiod möjliggörs även studium av pulsation i det intraokulära trycket. Denna pulsation kan påverkas av olika bakomvarande sjukdomstillstånd.

Patentkrav

1. Metod för bestämning av trycket p i ett öga, det sk intraokulära trycket, innefattande att en kontaktkropp med känd geometri ansätts mot ögat med en successivt ökande kraft F och att när ögats deformationsarea A kan bestämmas erhålls trycket ur sambandet $p=\frac{F}{A}$, k ä n n e t e c k n a d a v att frekvenskarakteristiken hos ett kontaktkroppen tillhörande och i resonans svängande sensorsystem avläses, att kontaktkroppen ansätts mot ögat för bildandet av ett nytt i resonans svängande system, att ansättningskraften och frekvenskarakteristiken avläses för det nya systemet och att förändringen i frekvenskaraktäristik beräknas, varvid ögats tryck kan bestämmas då den eftersökta deformationsarean A är en funktion av förändringen $A(\Delta f_{karr})$.

2. Metod enligt krav 1, k ä n n e t e c k n a d a v att den kraft med vilken kontaktkroppen ansätts mot ögat väljs beroende av ögats tryck, så att ett lägre tryck bestäms med en lägre ansättningskraft och ett högre tryck bestäms med en högre ansättningskraft, varvid erhålls hög mätnoggrannhet med minimal ansättningskraft i stora tryckintervall.

3. Metod enligt krav 1, k ä n n e t e c k n a d a v att frekvenskarakteristiken avläses kontinuerligt, att ansättningskraften F ökas till dess en önskad förändring i frekvenskarakteristik Δf_{karr} uppnåtts, att ansättningskraften F avläses och att trycket beräknas som en funktion av ansättningskraften F vid bestämd frekvenskarakteristikförändring Δf_{karr}.

4. Metod enligt krav 1 eller 3, k ä n n e t e c k n a d a v att upprepade avläsningar utförs av ansättningskraft F och frekvenskarakteristik under en ansättning av kontaktkroppen mot ögat, varvid en serie mätvärden erhålls.

5. Metod enligt något av kraven 1-4, k ä n n e t e c k n a d a v att frekvenskarakteristiken beskrivs av endera förändringen i resonansfrekvens Δf eller förändringen i fas $\Delta\varphi$.

6. Anordning för bestämning av det invändiga trycket i ett öga, det sk intraokulära trycket, uppvisande en kontaktkropp (4) för ansättning mot ett ögat (1) och ett organ (3) för bestämmande av den kraft med vilken kontaktkroppen ansätts mot ögat, k ä n n e t e c k n a d a v att kontaktkroppen (4) ingår i ett system svängande i resonans, att till resonanssystemet är anslutet ett organ (9) för avläsning av systemets frekvenskaraktäristik.

7. Anordning enligt krav 6, k ä n n e t e c k n a d a v att det i resonans svängande systemet innefattar ett piezoelektriskt element.

8. Anordning enligt krav 6 eller 7, k ä n n e t e c k n a d a v att kontaktkroppen (4) uppvisar en plan kontaktyta (5) och att kontaktytan företrädesvis uppvisar en struktur eller ett mönster.

9. Anordning enligt något av kraven 6 till 8, k ä n n e t e c k n a d a v att ett organ är anordnat för beräkning av förändring i frekvenskaraktäristik.

10. Anordning enligt något av kraven 6 eller 7, k ä n n e t e c k n a d a v att kontaktytan (5) är konkav, företrädesvis med en kurvradie överstigande kurvradien för den yta mot vilken den är avsedd att ansättas.

11. Användning av anordningen enligt krav 6 för mätning av pulsation i det intraokulära trycket.

Sammandrag

Föreliggande uppfinning avser en metod och en anordning för bestämning av trycket p i ett öga, det sk intraokulära trycket. Metoden innefattar att en kontaktkropp med känd geometri ansätts mot ögat med en successivt ökande kraft F och att när ögats deformationsarea A kan bestämmas erhålls trycketerhålls ur sambandet $p = \frac{F}{A}$, varvid frekvenskarakteristiken hos ett kontaktkroppen tillhörande och i resonans svängande sensorsystem avläses, kontaktkroppen ansätts mot ögat för bildandet av ett nytt i resonans svängande system, ansättningskraften och frekvenskarakteristiken avläses för det nya systemet och att förändringen i frekvenskaraktäristik beräknas. Sålunda kan ögats tryck bestämmas då den eftersökta deformationsarean A är en funktion av förändringen $A(\Delta f_{karr})$. Anordningen uppvisar en kontaktkropp (4) för ansättning mot ett ögat (1) och ett organ (3) för bestämmande av den kraft med vilken kontaktkroppen ansätts mot ögat, varvid kontaktkroppen (4) ingår i ett system svängande i resonans och att till resonanssystemet är anslutet ett organ (9) för avläsning av systemets frekvenskaraktäristik.

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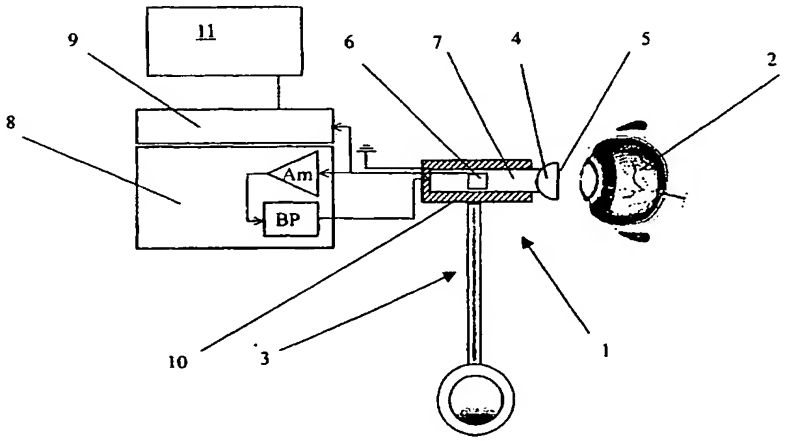
(54) Title: METHOD AND DEVICE FOR DETERMINING THE INTRAOCULAR PRESSURE, BY MEASURING THE CHANGING OF THE FREQUENCY CHARACTERISTICS



(57) Abstract: The present invention relates to a method and a device for measuring the pressure *p* in an eye, the so-called intraocular pressure. The method includes a contact body with a known geometry being pressed against the eye with a gradually increasing contact force *F* and that when the area of deformation of the eye *A* can be determined, the pressure can be obtained from the relation *P=F/A*, whereby the frequency characteristic of a contact body associated with a sensor system oscillating in resonance is read, the contact body is pressed against the eye to form a new system oscillating in resonance, the contact force and frequency characteristic for the new system is read, and the change in frequency characteristic is calculated. In this way, the pressure of the eye can be determined since the sought deformation area *A* is a function of the change *A(f¿ch ar?)*. The device has a contact body (4) for pressing against the eye (1) and a means (3) of determining the force with which the contact body is pressed against the eye, whereby the contact body (4) is part of a system oscillating in resonance, and the resonance system is connected to a means (9) for reading the frequency characteristic of the system.

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Method and device for determining the intraocular pressure, by measuring the changing of the frequency characteristics.

The present invention relates to a method and device for determining the internal pressure in an eye, the so-called intraocular pressure (IOP).

As long-term increased pressure in the human eye can lead to blindness, the pressure is routinely measured at all eye clinics. An applanation method is normally used at the clinic, e.g. the so-called Goldman applanation tonometer, which means that a probe is brought to press against the eye until a predetermined deformation is reached and the force required is read.

The basis of the pressure determination is then the known relation between pressure, force and area:

$P=F/A$ where P=pressure, F=force and A=area

The internal pressure of the eye can thus be calculated from the contact force against the eye and the area of deformation of the eye.

To establish that a specified deformation (area) has been reached, a fluorescent chemical is introduced to the eye and the eye is illuminated so that changes in light reflection at deformation can be read.

Another method is used when the demand on accuracy is not so high. It is a method where a jet of pressurised air is used to deform the eye with a specified force, whereby the deformation is read by detecting light reflections. This method has no physical contact between a fixed object and the eye.

Both methods are based on a force deforming the eye, which the patient can experience as being uncomfortable or painful, even though local anaesthetic is used with, for example, the Goldman method.

In addition, the former method has shown to be sensitive to astigmatism, as light refraction is always employed during measurement of the deformation of the eye. The latter method has documented shortcomings in precision and is thus not used when the nominal pressure is to be determined, but is often used instead by opticians, etc., for an initial measurement of the magnitude of the pressure.

There is always a risk of damaging the eye, especially the cornea, when the eye is pressed. This is one reason why it is desirable to minimise the contact force against the eye. The lowest force possible is determined according to the equation above by the area or deformation that is needed for this area to be correctly detected. The light reflection method that is used to detect or read the area of deformation requires a relatively large area for a correct reading and thus an equivalent relatively large force.

It is the aim of the present invention to alleviate or overcome the disadvantages stated above for known methods and devices for measuring the internal pressure in an eye.

This aim is achieved with a method and device that is first mentioned above and that has the characteristics that are defined in the following independent claims.

These and further characteristics and advantages of the invention will become evident from the following detailed description of preferred embodiments of the invention, which constitute an example and as such are not limiting for the scope of protection of the invention. To simplify understanding, the text includes references to an enclosed drawing. Fig. 1 shows schematically parts in a device according to one embodiment of the invention.

According to the present invention, a vibrating or oscillating contact body is pressed against the eye to determine the deformation of the eye.

We have found that changes in the frequency characteristic, between on the one hand a system oscillating in resonance and on the other hand the system partly brought into contact with an eye to form a new system oscillating in resonance, are dependent on the surface area of the contact.

One method for determining the pressure p in an eye, the so-called intraocular pressure, includes a contact body with known geometry being pressed against the eye with a progressively increasing force F and that when the deformation area A of the eye has been determined, the pressure is obtained from the relation $P=F/A$. New for the invention is to read the frequency characteristic f_{char} of a, to the contact body associated, sensor system oscillating in resonance, to thereafter press the contact body against the eye to form a new system oscillating in resonance, to read the contact force and the frequency characteristic for the new system, and to calculate the change in the frequency characteristic, whereby the pressure of the eye can be determined since the sought deformation area A is a function of the change $A(f_{char})$, calibrated for the actual sensor system. Calibration of the measurement instrument and measurement devices constitutes known moments and will therefore not be described in greater detail here.

The force with which the contact body is pressed against the eye can thus be adapted depending on the pressure of the eye so that a lower pressure is determined with a lower contact force against the eye and a higher pressure is determined with a higher contact force, whereby a high precision of measurement is obtained with minimum contact force over large intervals of pressure.

In an alternative embodiment, the frequency characteristic can be read continuously and the contact force F against the eye can be increased until a desired change in

the frequency characteristic Δf_{char} has been reached, whereby the contact force F can be read and the pressure calculated as a function of the contact force F at a specific change in the frequency characteristic f_{char}.

In a further embodiment, repeated readings can be made of the contact force F and the frequency characteristic while keeping the contact body pressed against the eye, whereby a series of measured values are obtained. A series of measured values increases the possibility of identifying and discarding measured values that fall outside the range of reliable measurements, for example, because the contact force was too low or because the force was so large that the deformation formed became larger than the area of contact.

During measurement and calculation of the frequency characteristic, components such as resonance frequency or phase can, for example, be used.

The enclosed figure shows schematically a device according to one embodiment of the present invention. The device shows a sensor 1 arranged in position to measure the intraocular pressure in an eye 2. The sensor 1 is supported by an arrangement 3 for regulating the pressing of the sensor 1 against the eye. Arrangement 3 can control the force with which the sensor is pressed against the eye.

The sensor includes a contact body 4 having a contact area 5 that abuts the eye.

The contact body is supported in the sensor by, or it forms an integrated part of, an oscillating unit. In the embodiment shown, the oscillating unit 7 is a piezo-electric element. The piezo-electric element is appropriately suspended in a casing 10 that allows the piezo-electric element to swing as freely as possible. Attached to the piezo-electric element 7 is a smaller piezo-electric element 6, a so-called pick-up, firmly fixed, which is used to capture the oscillations in the piezo-electric element.

A means of driving is connected to the oscillating unit 7 to achieve its oscillating movement. In the present embodiment, a feedback circuit 8 is connected to the piezo-electric element 7 to feed back the oscillations registered by the pick-up 6 and to achieve a resonance oscillation in the system.

In the embodiment shown schematically in the figure, the piezo-electric element 7 is connected to earth and to a band-pass filter BP. The pick-up 6 is glued firmly to the piezo-electric element 7 and connected to an amplifier Am, which in turn is connected to the band-pass filter BP for feed-back. Am and BP are tuned for optimal oscillation conditions, i.e. resonance frequency.

In addition, a means 9 for reading the frequency characteristic is connected to the system. This can be an ordinary frequency counter or another instrument suitable for signal processing.

Furthermore, it is advantageous if a calculator unit 11 is connected to the frequency counter for calculating the frequency difference.

In this embodiment, the contact surface is flat. The surface can, for example, be provided with a structure or pattern to displace the tear fluid. The contact surface can also be made concave with a radius of curvature that exceeds that of the surface of the eye against which it is intended to be pressed.

In a further embodiment, the contact surface can also be made convex. This is preferable when, for example, measuring the pressure of an eye that has a flat cornea. Flat corneas can, for example, be the result for someone who has undergone correction of their sight by smoothing the cornea by treatment with a laser, for example.

The contact body should be made of an electrically insulating material that prevents galvanic connections between the piezo-electric element and the eye. The contact body can advantageously be made of a polymer material. In addition, the contact body should have acoustic properties that allow frequencies to be transmitted to the eye. The piezo-electric element should be encased to avoid galvanic connections between the piezo-electric element and body of the patient or the treating person.

When the system is brought to oscillate in resonance and the frequency characteristic of the system has been read, the system is ready for measurement. Contact surface 5 is brought oscillating against an eye whose pressure is to be determined. The contact force and the frequency characteristic for the system then oscillating in resonance are then read. One or more readings can be taken for each occasion of measurement.

With the help of the previously made calibrations of the sensor system, the contact area can be interpreted from changes in frequency characteristic $A(f_{char})$ and the pressure of the eye can be established.

To obtain reliable values, the area of the contact surface (5) must exceed that area that is formed when pressing against the eye.

The advantage of the method described here is obvious as it does not require a predetermined area of deformation and thus no lower limit of contact force for determining the pressure. Furthermore, the use of fluorescent chemicals in the eye is avoided.

As the device can be used for continuous measuring and gathering of information, it is also possible to study the pulsation in the intraocular pressure during a period of measurement. This pulsation can be affected by different underlying illnesses.

Claims

1. Method for measuring the pressure p in an eye, the so-called intraocular pressure, that includes a contact body with a known geometry, being pressed against the eye with a gradually increasing force F and that when the area of deformation of the eye A can be determined, the pressure can be obtained from the correlation, $P=F/A$ characterised in that the frequency characteristic of a contact body associated with a sensor system oscillating in resonance is read, that the contact body is pressed against the eye to form a new system oscillating in resonance, that the contact force and frequency characteristic for the new system is read, and that the change in frequency characteristic is calculated, whereby the pressure of the eye can then be determined since the deformation area A sought is a function of the change $A(f_{char})$.

2. Method according to claim 1 characterised in that the force with which the contact body is pressed against the eye is chosen depending on the pressure of the eye, so that a lower pressure is determined with a lower contact force against the eye and a higher pressure is determined with a higher contact force, whereby a high degree of measurement accuracy is obtained with a minimal contact force over a large pressure interval.

3. Method according to claim 1 characterised in that the frequency characteristic is read continuously, that the contact force F is increased until a desired change in the frequency characteristic f_{char} has been reached, that the contact force F is read and that the pressure is determined as a function of the contact force F at a specified change of frequency characteristic f_{char}.

4. Method according to claim 1 or 3 characterised in that repeated readings of the contact force F and frequency characteristic are made while the contact body is pressed against the eye, whereby a series of measurement values are obtained.

5. Method according to any of claims 1-4 characterised in that the frequency characteristic is described by one of either the change in resonance frequency f or the change in phase φ.

6. Device for measuring the internal pressure in an eye, the so-called intraocular pressure, having a contact body (4) for pressing against the eye (1) and a means (3) of determining the force with which the contact body is pressed against the eye, characterised in that the contact body (4) is part of a system oscillating in resonance, and that the resonance system is connected to a means (9) for reading the frequency characteristic of the system.

7. Device according to claim 6 c h a r a c t e r i s e d in that the system oscillating in resonance includes a piezo-electric element.

8. Device according to claim 6 or 7 c h a r a c t e r i s e d in that the contact body (4) has a flat surface of contact (5) and that the contact surface preferably has a structure or a pattern.

9. Device according to any of claims 6 to 8 c h a r a c t e r i s e d in that a means is arranged for calculating the change in frequency characteristic.

10. Device according to any of claims 6 or 7 c h a r a c t e r i s e d in that the contact surface (5) is concave, preferably with a radius of curvature that exceeds the radius of curvature of the surface of the eye against which it is intended to be pressed.

11. Use of the device according to claim 6 for measuring pulsation in the intraocular pressure.

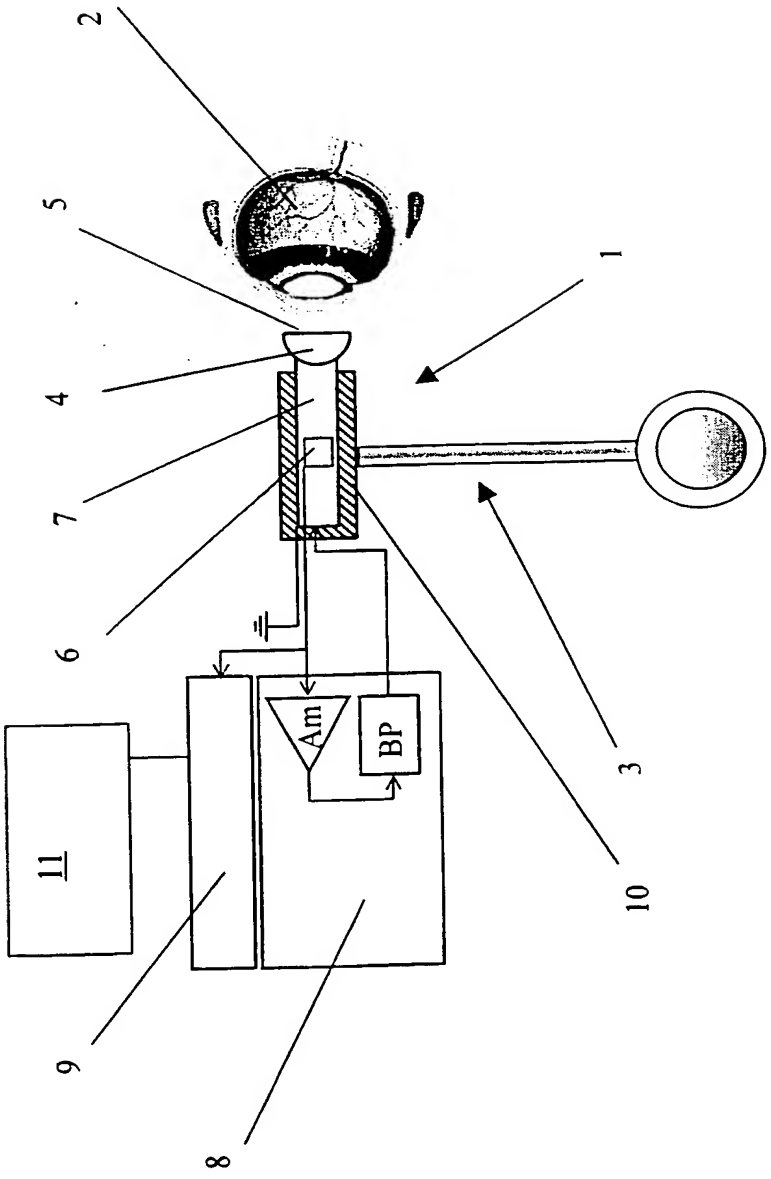

fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/01628

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61B 3/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5375595 A (D.N. SINHA ET AL.), 27 December 1994 (27.12.94), figure 1, abstract ---	1-11
A	SU982649 A (RYAZAN WIRELESE ENG INST) 1982-12-28 (abstract) World Patents Index (online).London. U.K.: Derwent Publications, Ltd. (retrieved on 2000-05-29). Retrieved from: EPO WPI Database. DW8342, Accession No. 83-793928 ---	1-11
A	US 4930507 A (E.J. KRASNICKI ET AL.), 5 June 1990 (05.06.90), figure 2, abstract --- --------	1-11

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 December 2000	07 -12- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Patrik Blidefalk/AE Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 00/01628

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5375595 A	27/12/94	NONE	
US 4930507 A	05/06/90	NONE	